

Under Pressure: Subduction Zones

Material adapted from:

*NOAA Satellite and Information Service, National Geophysical Data
Centre: Surface of the Earth Icosahedron Globe*

<http://www.ngdc.noaa.gov/mgg/fliers/04mgg02.html>

Introduction:

The boundaries where tectonic plates meet have obvious implications to the amount of seismic activity in an area, especially in zones where one plate sinks below another, subduction zones. In this class students will be introduced to the concepts behind subduction zones and how this unique plate margin has not only the potential to cause major earthquakes but also secondary effects such as tsunamis through modeling and mapping.

Materials:

(Materials in **bold** are provided by SMILE)

Sticky Notes (3 different colors)

White Index Cards

Crayons/Markers

Scissors

Rulers (Optional)

Tape

Materials provided are enough to support **10** student groups

Handouts/Overheads:

Subduction Zone Overhead

Sticky Note Cascadia Subduction Zone Overhead

Icosahedron Globe Handout (20 copies provided)

Major Global Subduction Zones Map

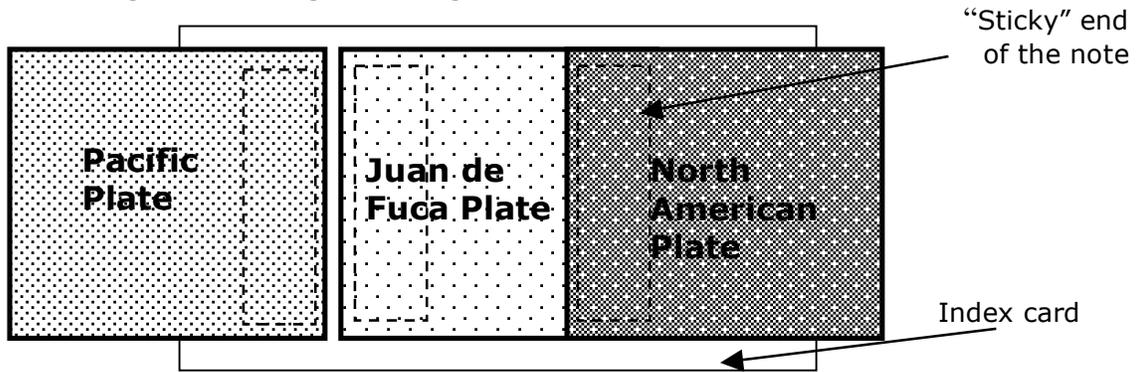
USA Atlas (Optional)

Activity 1: Sticky Note Subduction Zones

1. Review plate tectonics and how different plate boundaries have different characteristics. Focus attention to subduction zones and how one tectonic plate sinks below another at these unique boundaries.

Describe the immense pressure that can build between the plates as one descends below the other, often leading to intense earthquakes and/or volcanoes on land in proximity to the boundary when the pressure is released. Discuss how there is a subduction zone not far off the Oregon coast: the Cascadia Subduction Zone.

2. Ask the students to work with a partner. Give each group 3 different color sticky notes and an index card. The students are to make a simple model of the Cascadia subduction zone. Ask them to put the model together using the diagram below



3. The students can now model the force of two tectonic plates pushing against each in a subduction zone.

To do this one student should hold the model in the air, touching the index card only and keeping it horizontal, whilst another student places a paperclip across the overlap between the North American note and the Juan de Fuca note. The same student should now push the right edge of the North American note toward the Juan de Fuca so it starts to fold up.

With continual force, the North American note will come unstuck and 'flick' the paperclip off. The students can repeat this a few times if necessary and it may work more successfully if the adhesive on the notes start to wear down.

The North American note being 'stuck' to the Juan de Fuca represents how in the Cascadia subduction zone the two plates are locked together and pushing against each other as the Juan de Fuca slides beneath the North American plate. The huge frictional forces produced from this action causes pressure to build at the interface, being suddenly released at a critical point. The action of the North American note suddenly becoming unstuck and the paperclip 'flicked' off as force is acted upon it represents this sudden release of pressure and helps

realize how large volumes of seawater can be displaced by this sudden deformation at the tectonic plate boundary, possibly forming a tsunami. It is this 'flick' action that makes a subducting boundary different to other tectonic boundaries. This can be seen though the Pacific and Juan de Fuca boundary being unaffected in the model.

Activity 2: Tsunami Risk Globes

1. Describe to the students that underwater subduction zone earthquakes over an 8.5 magnitude have the capability of causing ocean-wide tsunamis through a massive displacement of water as the zone deforms.
2. Give each student a copy of the icosahedron globe handout and explain that they are to make a globe from a flat map, representing the areas on earth most likely to be affected by tsunamis. Discuss with the students the relevance of using an icosahedron as a representation of a spherical object and how geoscientists use triangles and icosahedron patterns to map Earth's topography with satellites and GIS (Geographical Information Systems) spatial data. The shaded areas the relief of the continental surface and the sea floor on the icosahedron map.
3. Firstly the students should use markers and/or crayons to color the flat globe, e.g. blue for ocean, green for continent, brown for major mountain ranges, so as to enhance the shaded surface of the map. An atlas or the world tsunami events map can be used for reference.
4. Using the world tsunami events map, students can now mark on their flat globes areas most prone to tsunamis, using their choice of symbols and/or shading.
5. Next each student should carefully cut out the globe. The icosahedron includes markings for tabs and corresponding slots, so the globe can be assembled without glue or tape, if desired. Thus, you can choose whether you wish the students to cut the map with the tabs and have them assemble by placing the tabs in the slots (they would have to cut these out too) or by taping or gluing the tabs to the globe sides. Either way, the students should cut the globe out carefully, making sure they do not cut off any of the tabs. There is also a separate smaller piece to cut out at the bottom of the sheet to use as a stand for the final globe.

Once the globe is completely cut out, the students should fold carefully along all the triangles to make assembly easier and the final globe more precise, using a ruler may help for this.

6. Now the students can start assembling the globe by folding the triangles together and securing with tape/glue (or pushing the tabs in the slots). They may find it a little tricky at first but a little patience goes a long way! Once the globe is assembled, the stand can be made for the globe to rest in.

7. Students should take a look at their icosahedron globe and notice the areas on earth in proximity to subduction zones and most at risk to tsunamis.

Questions to ask the students:

- Are there any patterns?
- Are the students aware of any of the past tsunami events marked on their globe? If so, which ones?
- How far from the subduction zone do they think people would have to be to not be under any threat to a seismic event?
- How much risk is there for the USA?

Class Extensions:

- Choose one of the subduction zones on the globe and have the students research in teams any recent seismic events that have taken place in association with that zone. How frequently does this zone cause events that may be deemed hazardous to a populated area? Does this frequency show a lower or possible even higher risk to seismic events? Are there any plans in place to prepare for these hazards?